

INDOOR AIR QUALITY ASSESSMENT

**Massachusetts Department of Revenue
Child Support Enforcement Division
Route 6A
Barnstable, Massachusetts**



Prepared by:
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Bureau of Environmental Health Assessment
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Background/Introduction

In response to a request from Rosemary Day, Department of Revenue (DOR) Deputy Commissioner, an indoor air quality assessment was done at the Barnstable DOR, Child Support Enforcement Division (CSE) facility at Route 6A, Barnstable, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA).

On September 20, 2000 a visit was made to this building by Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ). The CSE is located on the second floor of a two-story, wood frame office building. The windows in this building are openable.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, model 8551.

Results

The CSE offices have an employee population of 15. The adjacent DOR office contains approximately 45 employees. The tests were taken under normal operating conditions. Test results appear in Tables 1-2.

Discussion

Ventilation

It can be seen from the tables that the carbon dioxide levels were above 800 ppm in all areas sampled, which indicates problems with the ventilation system. Ventilation is provided by

heat pumps located in closets in several areas in the DOR offices. Heat pumps are connected to ductwork above the ceiling that distributes air to ceiling mounted air diffusers. Air diffusers are designed to create airflow by directing air to move along the ceiling and walls, which allows for air to mix and to create circulation. An examination of these heat pumps did not reveal any ductwork that could serve as a source of fresh air for these units.

In addition, heat pumps do not provide exhaust ventilation. Return air is drawn to the heat pump by a passive vent that exists in the wall of the heat pump closets. This system is designed to draw return air from the office directly into the heat pump. The DOR offices do not appear to be designed to have mechanical ventilation that will provide fresh air or to exhaust air from the space. With the lack of a fresh air supply or exhaust ventilation, pollutants that exist in the interior space will not be diluted and will build up and remain inside the office.

In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air. The date of the last servicing and balancing of these systems was not available at the time of the assessment

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself at levels measured in this building. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it

indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings at the DOR offices ranged from 67° F to 75° F, which was below the BEHA comfort range for some areas. The BEHA recommends that indoor air temperatures be maintained in a range of 70° F to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in this building was within the BEHA recommended comfort range in all areas sampled. Relative humidity measurements ranged from 43 to 53 percent. The BEHA recommended comfort range is 40 to 60 percent. Relative humidity levels in this office would be expected to drop during the heating season. The sensation of dryness and irritation is common in a low relative humidity environment. For buildings in New England, periods of low relative humidity during the winter are often unavoidable.

Microbial/Moisture Concerns

The mainframe room contains an air conditioning unit (see Picture 1). A pipe system is installed in this unit to drain moisture generated by the cooling coil of this unit. A condensation pump is used to impel condensation into the drain. Wallboard around the condensation pump appears to have been repeatedly wet, resulting in possible mold growth (see Picture 2). In addition, this area also had a water-damaged ceiling tile. If repeatedly moistened, ceiling tiles and wallboard can serve as a medium for mold growth.

Water coolers are located in several areas directly on carpeting. As previously noted, porous materials that are repeatedly wet can serve as media for mold growth. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If porous materials, such as wallboard and carpeting are not dried within this time frame, mold growth may occur. Water-damaged carpeting cannot be adequately cleaned to remove mold growth.

Other Concerns

The handicapped rest room in the CSE area contains a shower that appeared to have a dry drain trap. Drains are equipped with drain traps that form a water seal to prevent the backup of odors. Without water, the airtight seal on the trap can be breached; resulting in sewer gas backing up the drains and entering occupied areas. Sewer gas can create nuisance odors and be irritating to certain individuals.

Air handling units/heat pumps are normally equipped with filters that strain particulates from airflow. In order to decrease aerosolized particulates, disposable filters with an increased dust spot efficiency can be installed. The dust spot efficiency is the ability of a filter to remove

particulates of a certain diameter from air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 % would be sufficient to reduce airborne particulates (Thornburg, D., 2000; MEHRC, 1997; ASHRAE, 1992). Note that increased filtration can reduce airflow produced by the heat pump by increased resistance. Prior to any increase of filtration, each heat pump should be evaluated by a ventilation engineer to ascertain whether it can maintain function with more efficient filters.

The design of the heat pumps does not allow for installation of filters within or on the unit. Filters for this system are installed within the return vent frame (see Picture 3). Two filters were installed within the return vent frame (see Picture 4) that did not fit flush with the rack. Filters should be one piece that fits flush with the filter rack. If two filters are to be used, the filter rack must have the appropriate equipment to make each filter fit flush in the rack. Air drawn into the return vent will bypass filters through spaces between filters and racks. This can result in dust, dirt and other debris being distributed by the ventilation system.

Activation of restroom exhaust vents is controlled by the light switch. When the light is turned off, the exhaust vent motor is deactivated. The exhaust vent motor creates negative pressure in the restroom to draw air and odors from the room. When deactivated upon exiting, odors within the restroom can linger and be drawn into adjacent areas by the main ventilation system.

Conclusions/Recommendations

The conditions found in the Barnstable DOR office present a complex series of problems that require a series of remedial steps. The lack of fresh air and exhaust ventilation results in air being re-circulated by the heat pumps in the DOR Offices. The

current mechanical ventilation system does not remove environmental pollutants from the building. This can result in a buildup of dust, dirt, and other pollutants in the indoor environment. In order to provide ventilation, windows are used to introduce air into the building. For this reason a two-phase approach is recommended, consisting of immediate **(short-term)** measures to improve air quality within the DOR and **long-term** measures that will require planning and resources to adequately address the overall indoor air quality concerns within this office.

In view of the findings at the time of this visit, the following **short-term** recommendations are made:

1. Operate the rest room exhaust vent to prevent odors entering occupied areas.
Consider placing a timer to run the vent system during office hours.
2. Replace the filters in the return vents with one that fits flush within the filter frame. Consideration should be given to providing a higher efficiency air filter for the HVAC system in order to prevent odors and dusts from being entrained by the heat pumps.
3. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations). Consider obtaining a vacuum cleaner equipped with a high efficiency particulate arrestance (HEPA) filter to trap respirable dusts.

4. Replace water damaged wallboard around the condensation pump in the computer mainframe room.
5. Replace the water damaged ceiling tile in the main frame room.
6. Consider placing plastic/rubber mats beneath water coolers.
7. If not in use, seal unused shower drain in the handicap restroom or pour water down regularly to prevent sewer gas back up.

The following **long-term** measures should be considered.

1. A ventilation engineer should be consulted to ascertain whether a mechanical fresh air supply and exhaust ventilation for the AHUs can be installed.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

ASHRAE. 1992. Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 52.1-1992.

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

MEHRC. 1997. Indoor Air Quality for HVAC Operators & Contractors Workbook. MidAtlantic Environmental Hygiene Resource Center, Philadelphia, PA.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R. 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Thornburg, D. 2000. Filter Selection: a Standard Solution. *Engineering Systems* 17:6 pp. 74-80.

Picture 1



Mainframe Room Air Conditioning Unit

Picture 2



Water Damaged Wallboard below Condensation Pump in Mainframe Room

Picture 3



Filters

Return Vent with Filter Installations

Picture 4



Two Filters Installed in Return Vent Rack, Note See-through Quality of Filter Media

Remarks	Carbon	Temp.	Relative	Occupants	Windows	Ventilation		Remarks
	Dioxide *ppm	°F	Humidity %	in Room	Openable	Intake	Exhaust	
Outside (Background)	418	68	78					Weather conditions: windy, overcast
Conference Room	864	68	51	1	Yes	Yes	No	Door open
Main Office NE	833	69	51	6	Yes	Yes	Yes	
Finn Office	824	69	50	0	Yes	Yes	No	
Private Office	854	67	48	1	Yes	Yes	No	Door open
Main Office SE	848	69	49	4	Yes	Yes	Yes	Fan
Main Office SW	915	70	51	2	Yes	Yes	Yes	Supply blocked by paper
Main Office NW	879	71	49	0	Yes	Yes	Yes	Plants
Storage	842	71	49	0	No	No	No	
Men's Restroom	871	71	50	0	No	Yes	Yes	Exhaust off-tied to switch, 1 CT
Women's Restroom	849	71	49	0	No	Yes	Yes	Exhaust off
Handicap Restroom	851	71	49	0	No	Yes	Yes	Abandoned shower
Audit Cubicles	1425	74	53	8	Yes	Yes	No	
Comptrol	1390	74	50	1	No	Yes	Yes	

TABLE 14

Indoor Air Test Results – Department of Revenue, Route 6A, Barnstable, MA – September 20, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Storeroom	1309	74	49	0	No	No	No	
Conference Room	1176	74	48	0	No	Yes	No	Door open
Lunch Room	1299	75	49	2		Yes	Yes	Exhaust off, sliding door
Lunch Room Hall								Water cooler
Process Manager's Office	1389	75	48	1	No	Yes	Yes	Supply and exhaust off, door open
Main Frame Room								Water damaged wallboard, 1 CT
North Cubicles	1311	72	44	7	Yes	Yes	Yes	
Field Office Bureau (North Cubicles)	1245	72	43	2				

Comfort Guidelines

* ppm = parts per million parts of air
CT = water-damaged ceiling tiles

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%